Ministry of Higher Education and Scientific Research
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Practical work $N^{\circ} - 3$

Supercapacitor modeling

1 Two-branch model

It's a simple electrical circuit model subject to localized constant models, and faithfully describes the electrical behavior of the supercapacitor.

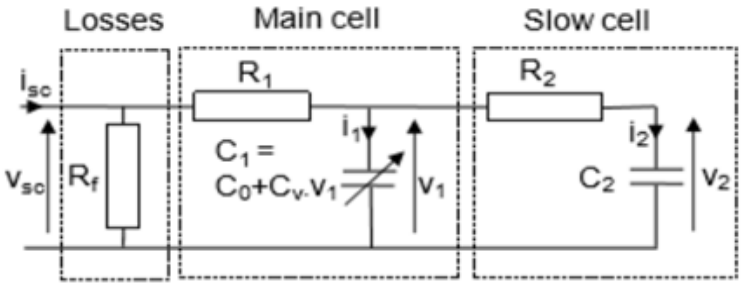

Figure 1: Two-branch model.

$$V_{sc} = V_1 + R_s.i_s \tag{1}$$

With : $V1$: The voltage at the terminal of $C1$ in (V).
$R1$: The resistance value of the main branch in (Ω).
The supply current is shown as follows:
$i_{sc} = i_1 + i_2$
Or: i_1: The current at the input of capacitor C_1 in (A).
i_2 : The current at the input of capacitor C_2 in (A).
The capacitance C_1 of capacitor 1 is given by :
$C_1 = C_0 + C_v.V_1.$
$$\mathrm{V}_1 = \frac{-C_0 + \sqrt{{C_0}^2 + 2C_v}}{C_v.Q_1}$$
The total terminal voltage of a group of supercapacitors connected in series and in parallel is :

$$U_{sc} = N_s.V_{sc} = N_s.(R_1.I_{sc} + V_1) \tag{2}$$

We use a DC current source equal to 250 A knowing that :
$R_1 = 0.00036\Omega, R_2 = 1.92\Omega, C_0 = 2100F, C_v = 623F/V, C_2 = 172F, N_s = 6, N_p = 6,$

1.1 Equivalent electrical model of a supercapacitor

(Simulation time 200 s)
Demonstrate the model using the expressions in figure-2 ? Realize and visualize all

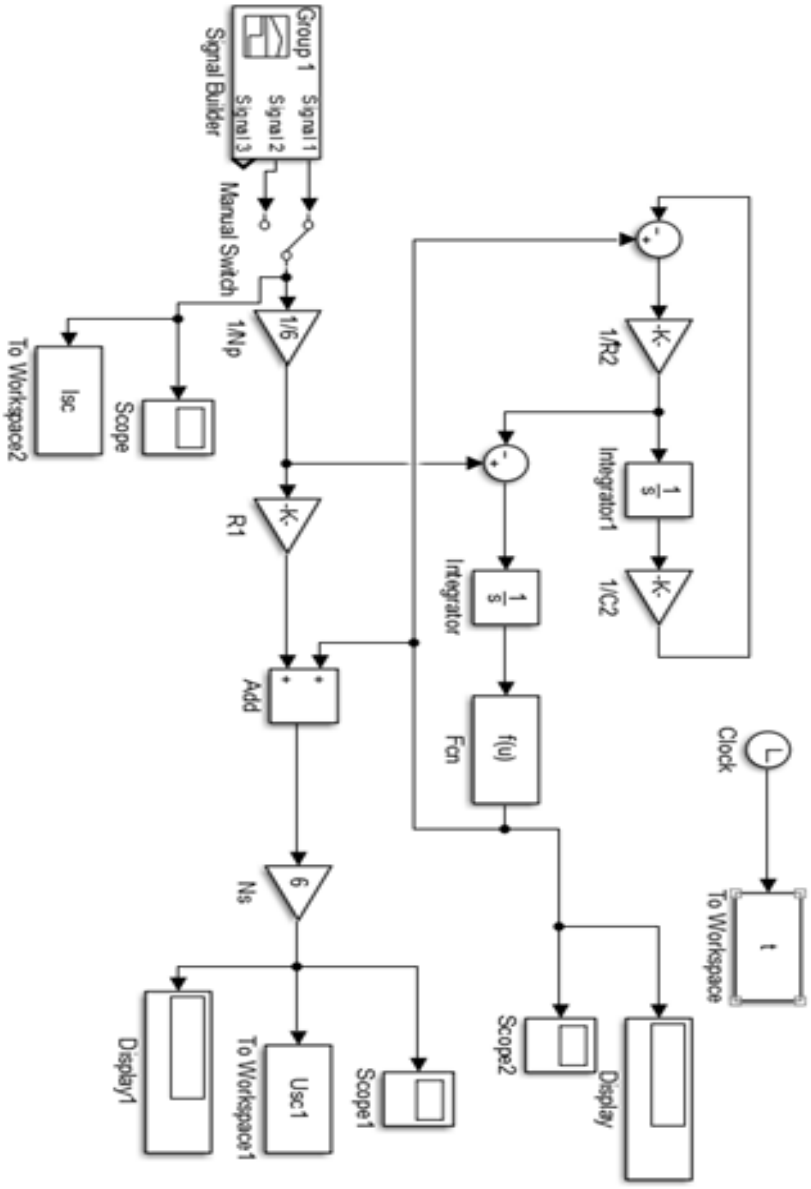

Figure 2: Equivalent electrical model of a supercapacitor in Simulink .

curves.(Simulation time 280000 s).

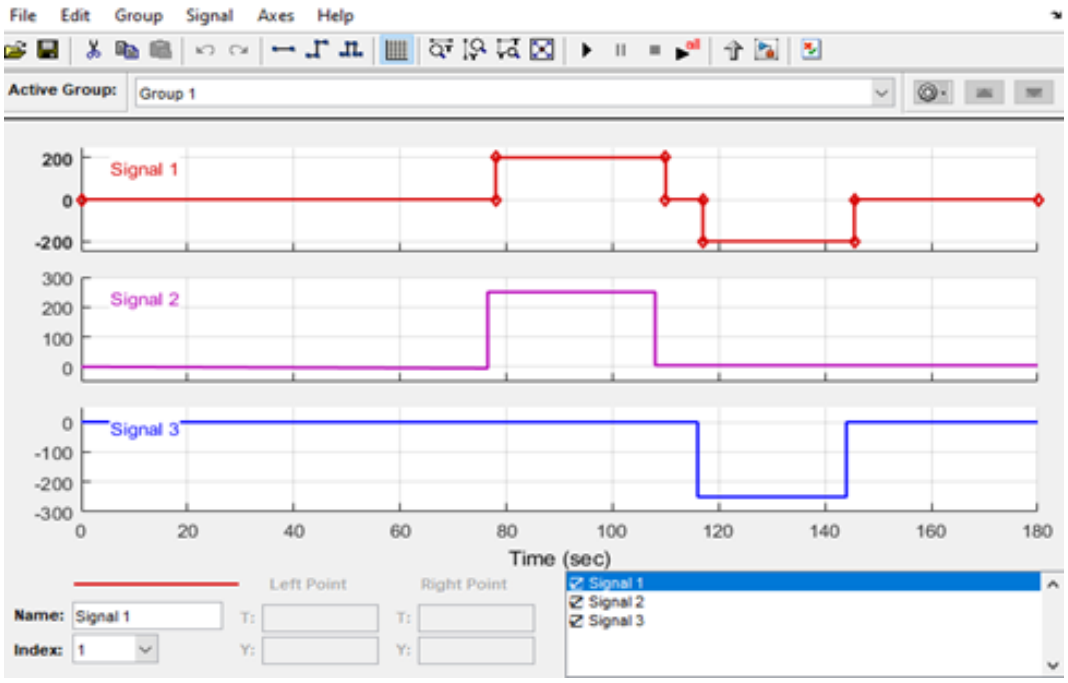

Figure 3: Signal builder curves

1.2 Questions

❶ What is the purpose of Practical work ?

❷ How does this block work ?

❸ What did you visualize with the oscilloscope ?

❹ Interpret and conclude the results